

## Millimeter and Submillimeter Observations of Protoplanetary Disks

David Wilner

(Email: [dwilner@cfa.harvard.edu](mailto:dwilner@cfa.harvard.edu))

Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts

I will review recent progress in understanding protoplanetary disks around young stars from observations at millimeter and submillimeter wavelengths. With typical temperatures of 30 to 100 K at distances of 10 to 100 AU from a Sun-like star, the disk material is cold and this spectral region is rich in diagnostic probes. Solids are accessible through thermal continuum emission, and gas kinematics and chemical properties are studied through resolved images of line emission from trace molecular species. As an added bonus, the stellar photosphere is undetectable. Several interferometers (IRAM, OVRO, BIMA, NMA, SMA, ATCA, VLA) allow for imaging observations at Solar System size scales, in some cases reaching the Jovian orbit scale. The dust emission is almost entirely optically thin and allows for direct tests of physical models of disk structure. The spectral behavior of the dust emission shows indications of grain growth. ALMA, now under construction, will provide orders of magnitude improvement and revolutionize this field.

